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## Gasket Process Parameter in Metal Forming

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# Gasket Process Parameter in Metal Forming

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**Abstract.** Gaskets are very important in preventing leakage in the water piping system. Designing a gasket forming process is important to ensure that the products produced are as desired so that they can work optimally to prevent leakage. The use of software based finite element method is widely used in design to minimize the cost, time, and experimental material. In this study examined the effect of forming process parameters such as die type and friction coefficient of dies surface on gasket products. The results of the computer simulation, it is expected to get the best parameters to produce gasket products when gasket produced later.

## 1. Introduction

Research on gaskets has evolved over time. This development is in terms of materials and performance of the gasket system. In the case of materials known as metals, non-metals and semi-metals. One gasket made of metal is a corrugated metal gasket [1–3]. This gasket has a corrugated portion that produces high contact stress that can prevent leakage with low axial force. While the flat part serves as a spring so that it can maintain contact gaskets with flanges when the bolt loosens.

In the previous study the process of making corrugated metal gaskets using cold-press forming method. The dies type used is the open type. There are still found some defects in the forming results, especially at the peak of the corrugated part that still does not meet the entire surface of the dies [4]. This can affect the performance of the gasket when in contact with the flange surface, therefore the gasket does not work optimally to prevent leakage.

Product quality in the manufacturing process is affected by the coefficient of friction between the surfaces of the workpiece and die [5]. In the process of metal forming the type of die also affects the quality of the product produced [6]. At present, the development of software technology is advancing so that it is possible to predict the results of forming processes using simulation methods. With the right modeling, the amount and time of the experiment can be limited so that the costs incurred because the experiment process can be reduced

## 2. Methods

The method used in this study utilizes computer simulation with finite element method based software. The parameters of the forming process parameters in this study are the type of die and the coefficient of friction between the surface of the die and the workpiece. Dies type is opened dies and closed dies. Variations in the coefficient of friction are 0, 0.15 and 0.3. The quality of the gasket product is seen

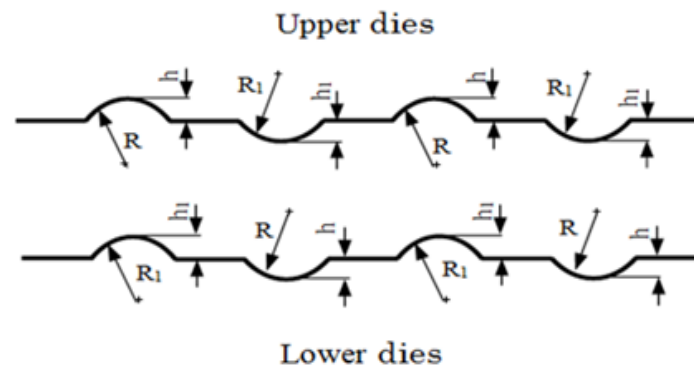


from the ability of the workpiece to fully fill the die mold form during the forming process. Besides that, it is also analyzed the magnitude of the die pressing force generated in the forming process.

The size of dies as shown in Table 1. The geometry of dies is shown in Figure 1. The material used as a gasket material is SUS304 with mechanical properties shown in Table 2.

**Table 1.** The dies dimension.

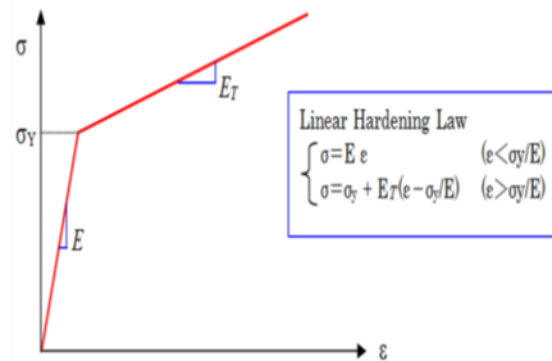
Factors	Dimension (mm)
Overhang (OH)	3
Pitch 1 ( $p_1$ )	3.5
Pitch 2 ( $p_2$ )	4.5
Pitch 3 ( $p_3$ )	3.5
Thickness (Tg)	1.5
Radius (R)	2.5
Radius (R1)	2.3
Height (h)	0.3
Height (h1)	0.33



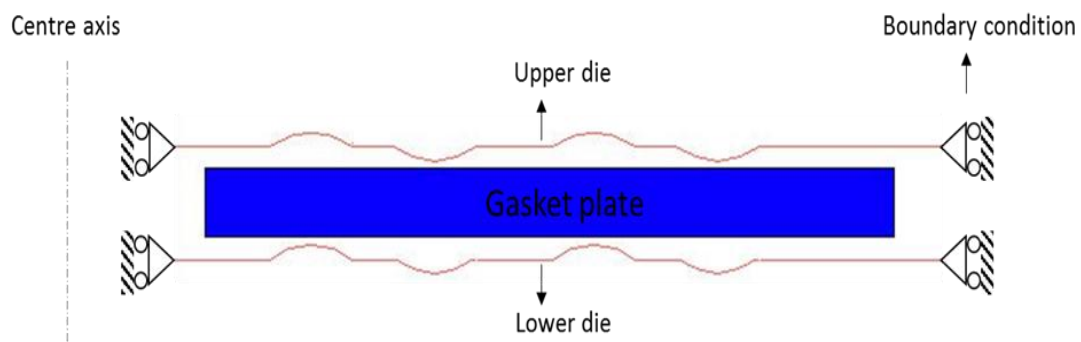
**Figure 1.** Dies geometry.

**Table 2.** Mechanical properties SUS304.

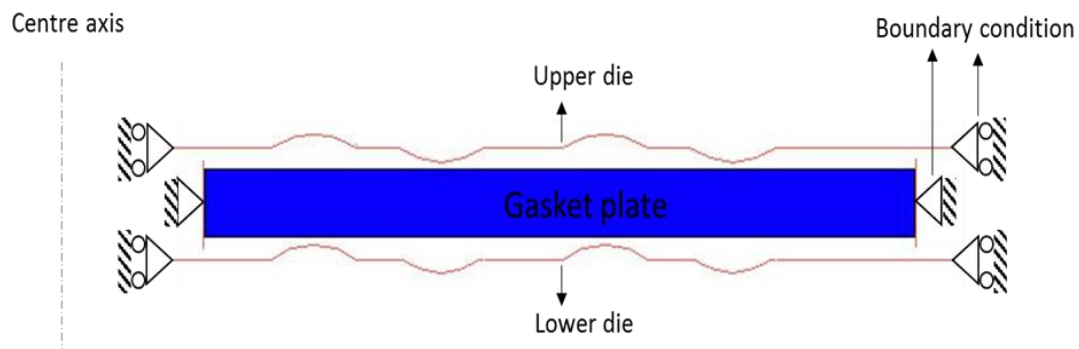
Properties	Value
Yield stress (Mpa)	398,83
Modulus tangen (Mpa)	1900,53
Modulus elastisitas (E) GPa	210
Poisson ratio ( $\nu$ )	0.3



**Figure 2.** Material model SUS304.



**Figure 3.** Simulation process for open dies.



**Figure 4.** Simulation process for closed dies.

In the simulation of forming process using axisymmetric analysis model. Gasket plate is deformable with a quadrilateral element type and 0.03 mm element size. Material gaskets meet the isotropic linear hardening law model (Figure 2). The upper die and lower die are assumed to be rigid. The simulation forming process uses the open die and closed die as shown in Figure 3 and Figure 4.

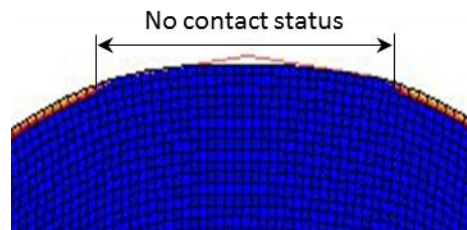
### 3. Results and Discussion

To analyse the results of the forming of good or no good corrugated metal gasket products, the main concern was directed at the four sections of the peak corrugated section of the metal gasket. This is because the performance of the corrugated metal gasket is affected by the peak of the corrugated gasket. The forming result is said to be good if the formed gasket meets the die completely. The indicator of fulfilling die mould in this simulation is indicated by the number of contact elements between the gasket plates and die mould (Figure 5). The more elements that contact the better the shape of the forming

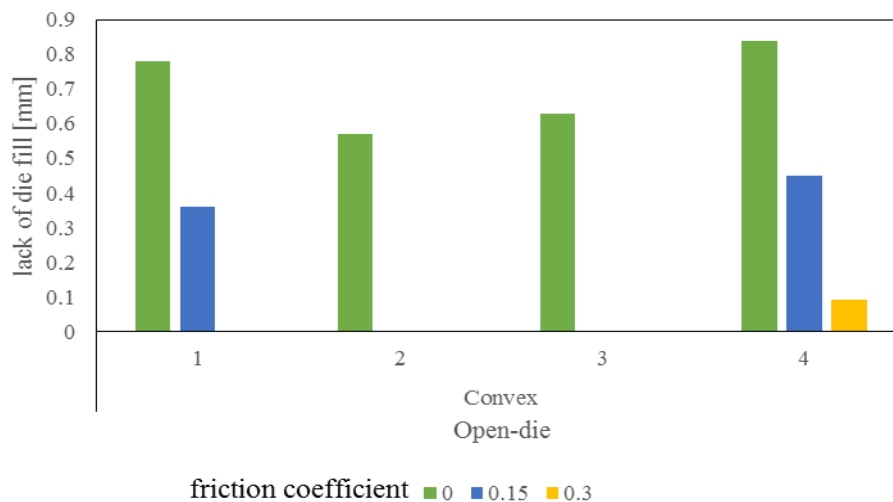
result. The elements that are not contacted are said to be forming products are defective.

Defective product = element size x number of elements that are not contacted

= 0.03 mm x number of elements that are not contacted

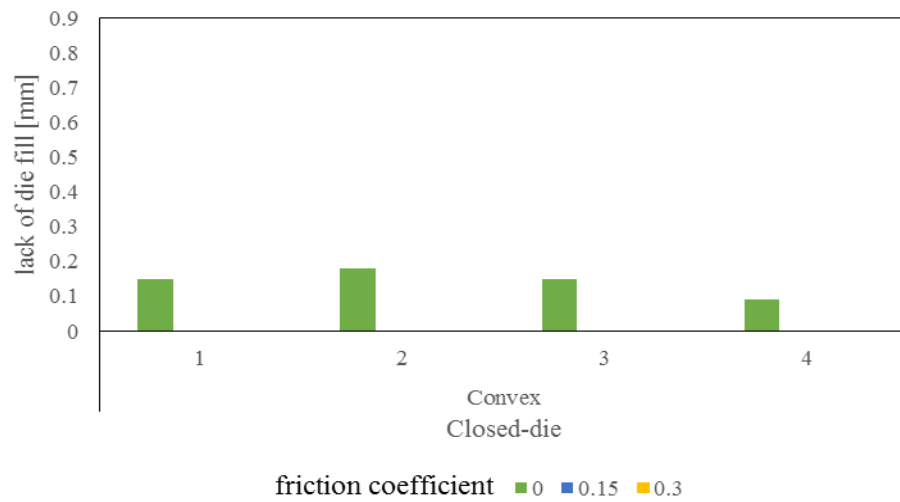


**Figure 5.** Contact status between gasket and dies.

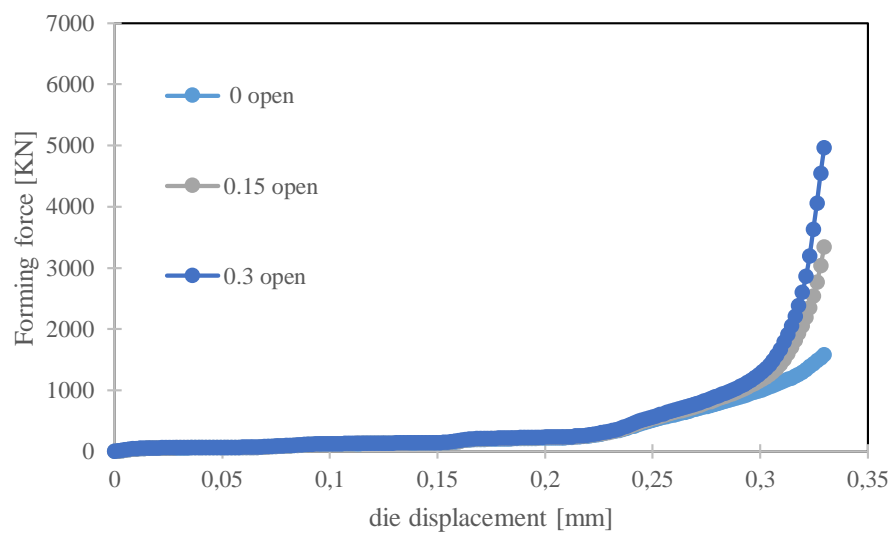


**Figure 6.** Lack of die fill for open dies.

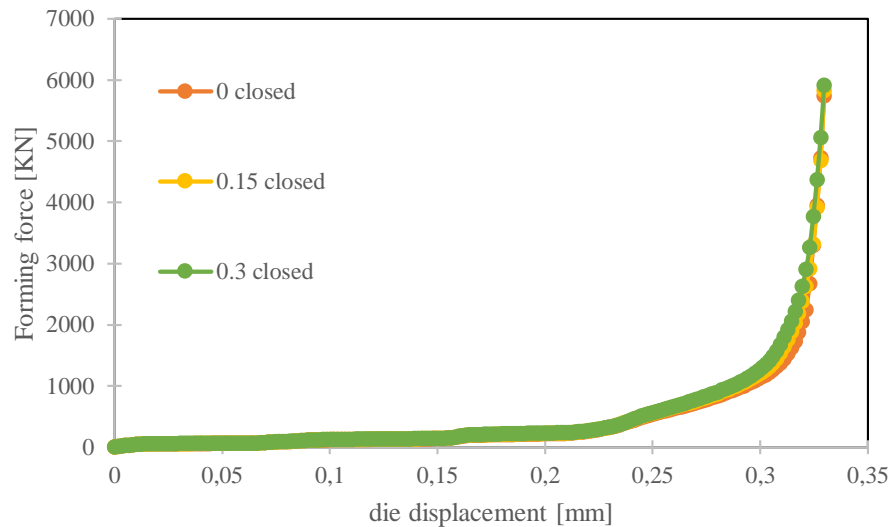
Based on Figure 6, it is shown for open die type, generally, with an increased coefficient of friction, the ability of the workpiece to meet the mold shape is better. This is indicated by the lower number of contact defects, especially on the Convex 2 and 3. For the open die with zero friction coefficient, there is still a contact defect because during the forming process, the workpiece other than the vertical direction but also has a long increase in the horizontal direction. In this case, the workpiece tends to increase in length towards the horizontal rather than deformed vertical direction. In the coefficient of friction 0.15 and 0.3 on convex 2 and 3, there is no contact defect, meaning that in that part the workpiece has fulfilled the mold form perfectly.



**Figure 7.** Lack of die fill for closed dies.



**Figure 8.** Forming force for open dies.



**Figure 9.** Forming force for closed dies.

For closed type die (closed-die) also shows the same trend, which with the increasing friction coefficient of the workpiece's ability to meet the die print form is getting better. In the coefficient of friction 0.15 and 0.3 in all parts of the convex, there is no contact defect, meaning that in that part the workpiece has fulfilled the mold form perfectly as shown by Figure 7. Figure 8 and 9 show a graph of the relationship of the coefficient of friction on the surface of the gasket with the die surface to the force of compression required. Seen with the increase in the coefficient of friction, the greater the pressure force required in the forming process. When compared between the types of dies obtained forming process with closed-die requires a greater force of emphasis.

#### 4. Conclusions

Based on the simulation results obtained:

1. The increase in the coefficient of friction between the surface of the gasket and die increases the ability of the workpiece to fill the mold contents, but the die compression force also increases.
2. The closed-die mold produces a better product than the open die, but the required die compression force also increases.

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